III. **REMARKS**

Examiner's Claim Rejection Section 1:

Section 112 Rejections

Claims 5, 6 and 25 have been amended to reflect the percentages by weight. A person of ordinary skill reading the discussion of a welding electrode in "solid form" would have understood that the percentage is a weight percent as an industry standard, however, the reference is now explicit.. Previous claim 25 is believed to have been understood in that sense from its dependency, as well, however the reference is now explicit.

Prior Art Rejections

Claim 1 and Moller

The Examiner rejects Claim 1 under on Section 102 based on Moller 4,875,657, a patent that observes the adverse properties of "soft welds" (Col. 1, line 16) and purports to advance a solution using aluminothermically produced steel casting.

One of ordinary skill will understand the process being described in Moller *et al.* to be aluminothermic. In the specification Moller describes "removal" of rail material as a result of molten metal being "poured". The present teaching is for a patentably distinct process.

Moller purports to remove a defect from a rail by pouring molten metal and then replacing the rail material with cast steel, the actual material is not described as anything other than "steel" and the properties of the molten material and the interaction with the rail material are not described in detail.

Claim 1 has been amended by limiting the method to a metal rail, exposing the parent metal, defining the shape of the void to have parallel walls and a floor and the welding process resulting in fusion of the molten metal to the parent metal.

As amended, the claim specifically sets forth the advantages taught in the present application (preferably, in the specification, by using gas metal arc weld (GMAW)) forming a shaped void or gap and enabling "fusion" between the molten metal and the parent rail metal. The claimed, process guarantees fusion of weld material to the parent metal by means of the high temperature associated with this arc welding process.

Moller's simple pouring of molten metal results in a metallurgically different "patch". It may be easy to apply and may be adequate for some purposes, but the present teaching and the claims call for removal of the defect, exposure of the parent metal of the rail and applying the molten metal in such a way that it fuses.

Moller not only does not teach or suggest a fusion capable process but an aluminothermic cast repair must necessarily have different metallurgy that makes fusion of the two materials doubtful. Thus, the presently claimed invention essentially eliminates the material differences between the molten metal and the parent, rail, metal. The claimed replacement material fuses with the parent material.

<u>Claim Rejection of Claim 1 Based on Obviousness</u>:

The Examiner rejects claim 1 as obvious under Section 103 based on Valley in light of Moller and Klumpes.

Valley et al. provides insight into rail welding technology. One of ordinary skill will know that Moller teaches aluminothermic casting, which has inherent metallurgical traits. Moller's aluminothermic casting is discussed in Valley, as is flash butt welding, the preferred welding method in Valley.

Valley, column 2 lines 39-59 and column 4 lines 10-25, teaches that two truncated ends are welded by means of flash-butt or friction welding. In these two cases, only parent metal is

used create the welded joint, which differs from the examiners statement, "filling the void with molten metal." Valley explains: "the repair is accomplished using only original rail material" (Col. 2, line 57).

Moller, as discussed above, does not machine or cut any parent metal, using, instead, molten metal to melt the rail and substitute for the metal of the rail. The amended claim is specifically limited to forming a gap or void, having walls and a floor. Moller does not teach this, and the flow of molten metal teaches away from this. Teaching away is an indication of non-obviousness. *KSR International Co. v. Teleflex Inc.*, 127 SCt 1727, 167 LEd2d 705, 82 USPQ2d 1385 (U.S. 2007), citing *United States v. Adams*, 383 U.S. 39, 40, 148 USPQ 479 (1966). Teaching away can rebut a *prima facie* case of obvious. *In re Peterson*, 315 F.3d 1325, 1331, 65 USPQ2d 1379 (Fed. Cir. 2003)

Klumpes creates a cavity -- surrounded on all sides by a cylindrical wall -- as is conveyed by the description of the process as boring. (Column 2 line 45 and Figures 1 and 4) The bored cavity is created in an iron casting and the bored cavity walls fully contains the molten slag. Repairing steel railroad rails requires a more refined metallurgical process than does simply filling a cavity in cast iron. Seemingly subtle differences in both the alloys and the process can themselves result in defects (Specification, Paragraph 25) the wrong alloy rod can result in brittle zones and the failure to fuse can result in weak areas.

In sum, therefore, these references teach: (1) completely cut out a piece of rail and flash butt forge the pieces to form a continuous rail (Valley); (2) encase a rail and melt away a defect, with the melt metal replacing the rail material when cooled (Moller); (3) bore a cavity in an iron casting as a reservoir for slag, the slag filling the cavity (Klumpes). Each purports to teach that it

is the best approach to the specific problem, but the three are neither successfully combinable nor would the person of ordinary skill look to combine them.

On-site rail repair, particularly durable, high quality rail repair, taxes metallurgical demands. Claim 1 as amended calls for slotting the rail, having substantially parallel walls and a floor, providing parent rail metal for welding -- and fusing thereto. Valley teaches to not use Thermite welds -- instead completely eliminating a section of rail. Valley is not combinable with a reference (Moller) from which it expressly teaches away.

Slotting and welding a steel rail head is similarly not taught by boring a small void from a cast iron work piece (Klumpe) especially where there is no adequate teaching of the metallurgy of the weld slag that simply fills the reservoir bored in the casting. Valley's avoidance of metals different from the parent rail metal teaches away from combination with Klumpes.

It is not believed that one would combine with Valley, completely different approaches of bringing aluminothermic (Moller) or filling a cavity with slag (Klumpes) especially when Valley teaches away from methods which bring in metals different than the parent rail metals.

<u>Claim 7</u>

Valley specifies a weld free of inclusions because this is a result of a flash-butt or forging weld. This weld is produced where the two members being joined are in a near molten state and are then compressed thus resulting in a forged type weld. This is free of inclusions due to the nature of the weld -- only parent metal is used and under forging pressure, inclusions do not occur.

The other weld common to the rail industry is the Thermite type weld, such as be used by Moller, which generally can include large gas pockets and inclusions as a function of the process used to generate the heat that causes the metal to become molten. As a dependent claim,

GMAW in accordance with the teachings herein results in a weld typically free of those types of defects. The claim also depends from an allowable base claim and should therefore be allowable.

Claims 10-12

Valley *et al.* requires severing a rail section to remove a defect. The claimed method requires only the removal of a defect in the head, with the limitation of maintaining the continuity of the rail section. This is patentably distinct from cutting entirely through a rail. The claims also depend from an allowable base claim and should therefore be allowable.

Claim 13

As stated by the examiner, Valley describes the interface between the rail sections as a flat surface and a void between the two rail ends. This clearly indicates a severed rail section where as in Kral, the claimed method requires removal of a defect in the head in a particular manner, while maintaining the continuity of the rail section, and therefore can be limited to a slot. The claim also depends from an allowable base claim and should therefore be allowable.

Claims 14-15

Valley describes truncated rail sections, which are severed creating two cross-sectional surfaces to be joined together by means of a flash-butt or a friction compression weld. No "root" is described in Valley. In the case of Klumpes et al., a description of a cavity is more accurately described in column 2 line 45 and Figures 1 and 4 resulting from a "boring" operation where as Kral describes a slotting operation. The base claim distinguishes over these references and the present claims more particularly define the weld root. The claims also depend from an allowable base claim and should therefore be allowable.

Claims 2, 3 and 22-23

Valley teaches a weld process that is flash-butt or friction compression weld, column 2 lines 39-59 and column 4 lines 10-25. Two truncated ends are welded by means of flash-butt or friction welding. As discussed above, Muller teaches aluminothermic casting and Klumpes simply filling a cavity in an iron casting with slag. Successfully arc welding railroad rails, as discussed in the specification, is not an easy task. See also Thelen, 7,123,990. The solutions discovered and the combinations claimed herein are not obvious. When considered in combination with the limitations in claim 1, particularly regarding maintenance of the parent metal and the limitation to fusion of the weld material therewith, a non-obvious combination is presented. Aluminothermic casts, filling cavities with slag, flash butt or friction welding of rails and imperfect or experimental full-rail arc welds are not claimed. The material limitations to the method taught are nonobvious. The claims depend from an allowable base claim and should therefore be allowable for that reason alone.

Claims 4 and 5

Claims 4 and 5 are limited to a particular metallurgy in an arc welding electrode -- high carbon in Claim 4 and an electrode comprising, by weight, about 0.1% to about 1.2% carbon, in Claim 5.

In the claims, as taught in the specification, the chemistry of the arc-welded weld material needs to be such that chemical differences between it and the parent rail material are minimized. No one, prior to the present invention, realized the importance of welding electrode composition in welding rails. Moller surmised that simply casting some sort of steel would make an adequate patch with no regard for the chemistry -- other than it being “steel”. Valley avoided the issue by welding rail directly to rail.

Irie states, in column 2 line 18-20, that the rail members themselves contain 0.7%-.82% by weight of carbon. In a manner analogous to Valley, at column 2 lines 25-28 Irie states "the said pair of rail members are directly joined with each other at least by electron beam welding." (emphasis added). This weld utilizes only parent material to create the welded joint. No additional electrode is used, so there is no discussion of the properties of added material. Backing material of a lower carbon alloy appears to be used only as a filler material not the weld material.

Irie, in fact, discusses the state of the art of electrodes, Col. 1, lines 26 – 32:

> "medium carbon steel, which contains a limited amount of carbon (C:0.33-0.38%) is usually used in view of the welding property. Cr, Mo, B and the like are added, resulting in the disadvantage that abrasion and settling occur around the transferring point more easily than high carbon steel treated with heat and high manganese steel."

But Irie's teaching is not to use a better electrode or arc welding technique, but rather to use a backing and electron beam welding to weld parent material to parent material. Irie observes "bad electrodes" but teaches away from the present solution.

Moller's "steel" may be of a wide variety of chemical compositions. Moller's "steel" could be low carbon, alloyed with different materials or could be relatively impure, such as if made aluminothermically, as by a Thermite weld (see Valley 6,515,249, Col. 1, lines 23 - 33). One principle that must follow from Moller is that the chemistry of the metals is essentially not considered. As a result, there may be expected to be an interface between metals of different properties. Principles of thermodynamics necessitate that, despite preheating, there will be metallurgy of fairly dramatic difference across interface between the cooled, cast-in-place material and the already in place rail.

Given the discovery of the significance of electrode chemistry to rail welding, and noting that such material was commercially unavailable in welding electrode form, the steps described with reference to and illustrated in Fig. 9 yield a non-obvious combination. No reference teaches anything about the chemistry of the weld material. Either no material is added (Valley, Irie) or only the most generic, like "steel" or "iron" (Moller, Klumpe) are used. The claims are not obvious. The claims also depend from allowable claims.

Claim 18

Valley describes a joining process in column 2, line 40-57, where the parent rail material is used to consume the defect. No electrode is used. In Irie, the method used is electron beam welding where no electrode is used. In Moller, aluminothermic consumption is used, not an electrode. While Thelen contemplates an electrode, it does not address the electrode's form or composition. At the time, it would not have been specified because the state of the art (Morlock, 5,773,779) did not understand the significance of the electrode. There can be alternative electrodes, but with the limitations of the base and any intervening claims, Claim 18, is non-obvious. It also depends from an allowable claim.

Claim 24

Claim 24, as amended, has limitations to the method of removal of the defect and the preservation of the parent material and fusing the molten material to the parent material. The molten metal has a carbon concentration of about 0.2% to 1.0% by weight.

Valley and Thelen, both teach that the defect be removed by severing the full cross-section of the rail and rejoining by means of flash-butt, friction compression, or GMAW welding, by definition, not maintaining continuity of the rail. Irie utilizes the rail material itself and a filler material of a lesser carbon content. As pointed out above, Irie simply notes that state

of the art electrodes have poor chemistry and poor results. Irie teaches away from an improved electrode or improved steps using particular electrode chemistry.

Moller describes a repair in the head of the rail without specifically stating it is maintaining continuity of the rail. Control over the flow of Moller's first shot of material provides limited control over continuity. Thelen, Valley, and Irie teach away from rail continuity, Moller does not affirmatively teach it. No one solves the problem of rail-weld chemistry, or suggests a solution. It would not be obvious, particularly in light of the teaching away by the references, to solve the rail welding problem with the claimed combination of steps.

Claims 8, 16, and 21

These claims each set forth particular limitations on the chemistry of the weld material. As discussed above, Valley and Irie have chemical continuity across the weld because the weld is done between parent rail metal. Thelen is silent on the chemical composition of the weld material. Moller and Klumpes are silent on the composition, using only generic terms capable of a wide chemical variation. Moller, being understood to be aluminothermic, may indeed necessarily be a material having residual components from the aluminothermic process.

These references simply do not imply or suggest the limitations. In fact they teach away. Further, the dependent claims depend from allowable claims.

Claims 6 and 25

As stated with respect to claims 8, 16, 21 and 24, the references cited do not at all teach or suggest a weld material that does not originate as parent rail material, and is also limited to the claimed chemical properties. The claims clearly differentiate between parent material in severed rail ends (Valley, Irie, Thelen) and weld material. The two "filling" or "patching" patents only

generically set forth the material -- “steel” or “iron” and they are inherently different because of the processes used -- aluminothermic or “slag”. The clearly do not teach use of electrodes.

Sato is addressed to a completely different problem. Sato’s electrode structure is formed to address welding members under stress. The present invention uses slotting and preservation of continuity in web and base to avoid the conditions of Sato. Sato teaches an electrode that is also described as having lower carbon content than that claimed. There is not even an overlap in the carbon ranges. Similarly, Sato’s nickel content is below the claimed range. It is respectfully submitted that Sato specifically teaches away from the compositions in the tables -- that is why Sato’s claims issued.

Claims 6 and 25	Sato’s Teaching
0.2% to about 1.0% carbon	0.005 to 0.05% carbon
1.8% to about 2.0% manganese	1.5 to 2.5% manganese
0.5% to about 0.6% nickel	0.25% nickel
0.5% to about 0.95% silicon	0.1 to 1.1% silicon

Sato does not suggest and is not combinable with a high carbon electrode used in slot-welding a rail head. Sato surely does not suggest the limitations of the claims -- claiming a broader range than the claimed range of manganese, overlapping silicon and teaching away from high carbon and nickel. Sato’s tables show carbon from 0.01 to 0.1 so not even the tables suggest the claimed content. Claims 6 and 25 are nonobvious and depend from allowable claims.

Claims 9 & 17

Claims 9 and 17 are limited to particular heat parameters. Starting with Moller, it is clear that so much heat is input into the system that it actually melts the rail itself. Moller may introduce different chemicals into the casting, but heat control is surely neither taught nor suggested. Similarly Valley's flash butt welding must impart sufficient heat to permit forging together the actual rail ends. All Klumpes does is fill a cast iron cavity with molten material. There is no consideration to heat transfer. The limitations of the claim focus on complex metallurgy and heat properties of two separate materials that are fused together, preserving the material properties of the whole. The claims depend from allowable claims and add significant limitations in the claimed field of rail repair.

Claim 19

Claim 19 adds limitations to an electrode treated to minimize hydrogen embrittlement. Caldwell identifies hydrogen embrittlement but in the claim, the solid electrode is specifically treated as to remove hydrogen. The claim also depends from allowable claims.

Claim 20

Irie describes a method joining the rails by using electron beam welding to join existing parent material from the rail. There is no use of a high carbon weld material, using instead low carbon filler material for a different reason -- owing to the joining of rails at an angle and the transition between the sectional shapes to a joined rail shape. The process in Moller is one where metal is poured to "cut" a defect out of the rail while simultaneously replacing the rail material with a cast steel, which is not described as a high carbon steel. The process claimed, is a GMAW. This process guarantees fusion of weld material to the parent metal by means of the high temperature associated with this arc welding process.

Conclusion

When considered for the entirety of their teachings, and in light of the amendments to the claims, the cited references neither anticipate nor make obvious the claims. The references, in fact, miss the mark, typically teaching different approaches -- Valley and Irie directly join parent rail material, Moller and Klumpes not teaching use of high carbon welding electrodes, and the other references similarly not teaching the limitations as cited above. Accordingly, allowance is earnestly solicited.

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Respectfully submitted,

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